RANGELAND CONDITION ASSESSMENT OF A PORTION OF THE CAL POLY SHEEP UNIT

A Senior Project
Presented to
the Faculty of the Animal Science Department
California Polytechnic State University, San Luis Obispo

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Bachelor of Science

by
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Abstract

This rangeland condition assessment was conducted as part of the Cal Poly Rangeland Condition Assessment Project. Five pastures comprising 31.7 acres at the Cal Poly sheep unit were assessed to collect baseline ecological information. Methods used were Line-point Intercept, Belt Transect, Residual Dry Matter, and the rangeland health indicators recommended by Pyke et al., 2002. Additionally, a preliminary species list was collected. The rangeland health assessment method found all pastures to have no to slight departure from the local reference area when evaluated for soil and site stability, hydrologic function, and biotic integrity.

Acknowledgments

This project would not have been possible without the support of Dr. Marc Horney, adviser, who provided providing equipment and advice and my trip to the training course on *Interpreting and Measuring Indicators of Rangeland Health*. The Earth and Soil Science Department provided the use of their drying ovens for RDM sampling.

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INTRODUCTION

The pastures and rangelands managed by Cal Poly San Luis Obispo are the focus of the new Cal Poly Rangeland Condition Assessment Project, led by Dr. Marc Horney of the Animal Science Department. This project aims to train students in rangeland resource assessment methods and interpretation of the information collected. My senior project was planned to contribute to this wider project. I assessed five pastures at the sheep unit using the standards and methods found in provided manuals, which are summarized in the procedures and methodology section. The pastures have a total area of 31.7 acres and are vegetated primarily by annual and perennial grasses. The locations and fences of these pastures are shown below on aerial imagery in map 1. A spring-fed watering trough is located at the junction of the five pastures. The pastures were not grazed throughout the duration of the assessment (September 20-December 13). Native herbivores present on the site included California ground squirrels (*Otospermophilus beecheyi*), black-tailed jackrabbits (*Lepus californicus*), and numerous grasshoppers.

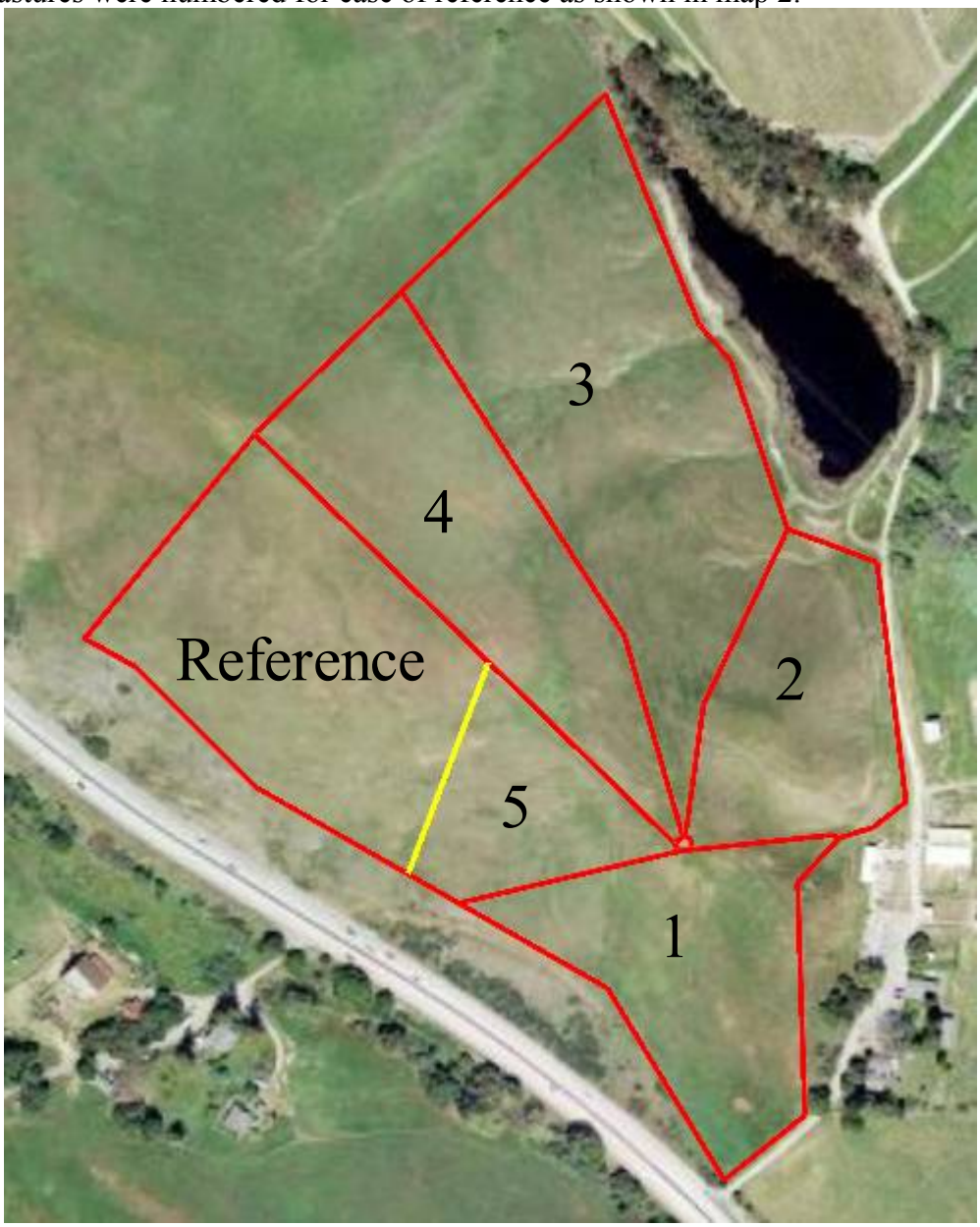
Map 1. Location of the pastures assessed at the Cal Poly sheep unit, with fences shown in red

OBJECTIVES

The objective of this project was to collect baseline information on the ecological condition of a portion of the sheep unit at Cal Poly San Luis Obispo. Data sets included Residual Dry Matter (RDM), Line-point Intercept, Belt Transect, and a plant species list. Additionally, the pastures were rated for rangeland health using the the rangeland health indicators recommended by Pyke et al., 2002. Following these assessments, observations were collected into this report.

PROCEDURES AND METHODOLOGY

The pastures were numbered for ease of reference as shown in map 2.



Map 2. Assigned numbers of the pastures assessed. The reference area was a portion of pasture 5, separated by the imaginary line shown in yellow. These lines are included with the report's data pack.

Line-point Intercept

Cover was estimated using the line-point intercept method. This method is described in Herrick et al. 2009. Lines (transects) were established on areas judged to be representative of the pasture. Factors used to make this determination were species composition, bare ground, level of grazing, and landscape position. The transect in

pasture 4 was placed so as to monitor the spread of a patch of *Centaurea solstitialis*, which was rare in other areas of the project's site. Data was collected along three line-point transects in the reference area. The first two transects were in grassland on the backslope of the hill. Both of these transects were 100 feet and points were spaced every two feet. The third reference transect was placed on the shoulder of the hill, which was largely bare ground and *Erodium botrys*. This and the transects in the five pastures were all fifty feet in length, with points spaced every foot. The start location of each transect was recorded by GPS (the unit used was a DeLorme PN-20), and the direction of the transect determined by a handheld compass. Data was recorded on the form provided in Herrick et al. 2009. Basal cover estimates are inaccurate due to the tendency of vertical grass stems to deflect the pin. Data was collected in late November and early December.

Belt Transect

Belt transects are used to collect data on the density of species of management concern. Using the method described in Herrick et al. (2009), data was collected along a 6 foot belt along the same transects used for line-point intercept. Species counted were perennial grasses *Nassella sp.* and *Phalaris aquatica*, invasive species *Foeniculum vulgare, Centaurea solstitialis*, and toxic herb *Eremocarpus setigerus*. *Picris echioides* was recorded in pasture 5 due to the weedy character of the herb in this pasture. Future belt collection may be able to determine if the weed is increasing in frequency. Shrubs were recorded when present. Data was recorded on the data form in Herrick et al. (2009) with a dot tally. Totals were used to estimate species density. Data was collected in late November and early December.

Residual Dry Matter

Residual dry matter (RDM) consists of dead plant material remaining from the previous growing season. The amount of RDM is influenced by plant productivity, grazing, and decay since the plants died. Data was collected for ten RDM clip plots distributed throughout the five pastures (including the reference area). Distribution was somewhat random, with a couple of areas chosen in each pasture and the exact location placed by throwing the PVC quadrat with eyes closed. The positions were recorded by GPS. The location of collection site 4 was lost but was in the upper area of the fifth pasture/reference area. The first four samples were collected with the 0.5 square meter quadrat, until it was judged to be excessively large for the amount of RDM present on the site. A 1 square foot quadrat was used for the six remaining samples. Samples were dried in a drying oven to remove moisture from Fall's early rains and dry the trace amounts of green grass seedlings. Samples were then weighed in grams by Dr. Marc Horney in the Cal Poly soils lab. This figure was then used to estimate RDM in pounds per acre. These figures were then used to estimate RDM across the five pastures. The RDM estimate was compared against the minimum RDM standards for coastal prairie found in Bartolome et al. (2006).

Plant Species List

Each pasture was walked in early December to record species present. The early rains of fall 2010 resulted in many seedlings and dormant plants emerging. Annual grasses were

unidentifiable at this time of year. Species were keyed using personal knowledge along with *The Jepson Manual* and CalPhotos.

Interpreting Indicators of Rangeland Health

This senior project was used as an opportunity to apply the training acquired in March 2010 on the use of the interagency qualitative rangeland health assessment method (ver. 4, 2005). In summary, this method compares sites against a reference site to determine the qualities of soil and site stability, biotic integrity, and hydrologic function. These qualities are determined using seventeen indicators. A reference sheet was developed by for this specific project since no Ecological Site Description has been written for this ecological site. The descriptions of the seventeen indicators on the reference sheet were based on the qualities of the indicators in the reference area. The reference area was selected based upon the absence of significant problems and low levels of grazing. The reference area was judged representative of a desirable state based upon several factors. The area had some of the highest density of *Nassella* grass and low levels of weeds relative to other areas of the sheep unit (determined visually). Bare soil in the reference area was limited to the upper area of the hill, and soil surface loss was low. The site lacked a gully in its one swale and no rills were present. A portion the hilltop area was included within the reference area to represent similar areas of low production resulting from soil type in other areas of the unit. The reference sheet was used to develop the evaluation matrix, which was used to rate the indicators in the pastures assessed. Soil surface stability samples were collected a random point along the line-point/belt transect tapes to rate indicator 8 (soil surface resistance to erosion).

ANALYSIS AND RESULTS

Line-point Intercept

Copies of the line-point intercept data forms are included in Appendix A. Photographs of the transects are included in Appendix B. The beginning points of the transects were located at the following coordinates:

Reference 1:	N35º 18' 48.54" W120º 41' 13.16"	100 ft. at an azimuth of 260º
Reference 2:	N35º 18' 49.07" W120º 41' 13.79"	100 ft at an azimuth of 205º
Reference 3:	N35º 18' 49.60" W120º 41' 13.12"	50 ft. at an azimuth of 80º
Pasture 1:	N35º 18' 45.66" W120º 41' 3.42"	50 ft. at an azimuth of 30º
Pasture 2:	N35º 18' 47.40" W120º 41' 2.97"	50 ft. at an azimuth of 190º
Pasture 3:	N35º 18' 53.38" W120º 41' 7.99"	50 ft. at an azimuth of 80º
Pasture 4:	N35º 18' 52.91" W120º 41' 9.27"	50 ft. at an azimuth of 144º
Pasture 5:	N35º 18' 46.97" W120º 41' 8.96"	50 ft. at an azimuth of 200º

The percent foliar cover, percent bare ground, and percent basal cover estimates are shown below in Table 1.

Table 1: Line-point Intercept data summary

Pasture	% foliar cover	% bare ground	% basal cover
Reference 1	94	6	4
Reference 2	100	0	2
Reference 3	56	44	0
1	94	6	8
2	56	22	4
3	88	10	2
4	94	6	2
5	96	4	2

Belt Transect

Copies of the belt transect data forms are included in Appendix C. The belts followed the same transects as the line-point intercepts and were six feet in width (3 ft on either side of the tape). Counts and density estimates are presented in Table 2 on the following page.

Table 2. Belt Transect data summary

Pasture	Species	Count	Density
Reference 1	*Nassella sp.*	206	14,767/acre (36,918/ha)
Reference 2	*Nassella sp.*	239	17, 133/acre (42, 832/ha)
Reference 3	*Nassella sp.*	2	287/acre (716/ha)
	Eremocarpus setigerus	12	1,720/acre (4301/ha)
1	*Phalaris aquatica*	31	4,444/acre (11111/ha)
	Nassella sp.	55	7,885/acre (19713/ha)
	Foeniculum vulgare (mature size class)	2	287/acre (717/ha)
2	*Nassella sp.*	123	17,634/acre (44,086/ha)
	Hazardia squarrosa	8	1,147/acre (2,867/ha)
	Foeniculum vulgare (mature size class)	7	1,004/acre (2509/ha)
	Foeniculum vulgare (seedling/<2' size class)	1	143/acre (358/ha)
3	*Nassella sp.*	93	13,333/acre (33,333/ha)
	Foeniculum vulgare (mature size class)	29	4,158/acre (10,394/ha)
	Foeniculum vulgare (seedling/<2' size class)	10	1,434/acre (3,584/ha)
4	*Nassella sp.*	119	17,061/acre (42,652/ha)
	Foeniculum vulgare (mature size class)		717/acre (1,792/ha)
	Foeniculum vulgare (seedling/<2' size class)	1	143/acre (358/ha)
	Centaurea solstitialis	72	10,323/acre (25,806/ha)
	Baccharis pilularis	1	143/acre (358/ha)
5	*Nassella sp.*	24	3,441/acre (8602/ha)
	Foeniculum vulgare (mature size class)	13	1,864/acre (4,659/ha)
	Picris echiodies	77	11,039/acre (27,599/ha)

Residual Dry Matter (RDM)
RDM estimates fell below recommended levels (minimum standards for coastal prairie in Bartolome et al. 2002) in three of the sample locations (3, 5, and 6) and was near the minimum standard in sample location 4. On average, however, the site exceeded the minimum standard by 79%. Photographs of the RDM sampling locations are included in Appendix D, and GPS coordinates in the data pack.

Table 3. RDM figures

Sample	Sample Area	Slope Class (%)	Net Sample Weight (g)	Estimated lbs./acre	Min. Std. lbs./acre
1	0.5 m²	10-20	240.65	4,294	1,500
2	0.5 m²	0-10	175.12	3,125	1,200
3	0.5 m²	>40	77.83	1,389	2,100
4	0.5 m²	20-40	101.45	1,810	1,800
5	1 ft²	20-40	15.86	1,523	1,800
6	1 ft²	20-40	5.41	520	1,800
7	1 ft²	10-20	73.55	7,063	1,500
8	1 ft²	0-10	38.19	3,668	1,200
9	1 ft²	10-20	25.22	2,422	1,500
10	1 ft²	0-10	21.76	2,090	1,200
Average				2,790	1,560

Plant Species List
The following plant species (Table 4) were recorded in the five pastures. Without a doubt there were some species which were present but not observed, or were still in the seedling stage. This list does not contain annual grasses, which were decayed to the point of being extremely difficult to identify. Judging from the Rangeland Productivity and Plant Composition chart in the soil survey, much of these annual grasses are brome species (*Bromus sp.)*. The chart also lists foothill stipa (*Nassella lepida*) as present on the main soil map unit found on the site, but due to the lack of distinguishing features present this time of year, purple needlegrass (*Nassella pulchra)* plants also listed could not be differentiated.

Table 4. Plant Species List

Pasture 1	**Notes**
Brassica nigra	
Calystegia subacaulis ssp. episcopalis	
Cynara cardunculus	
Cynodon dactylon	

Cyperus difformis	
Erodium botrys	
Erodium moschatum	
Foeniculum vulgare	
Geranium dissectum	
Hemizonia luzulaefolia	
Marrubium vulgare	
Medicago polymorpha	
Nassella sp.	
Phalaris aquatica	
Picris echioides	
Plantago lanceolata	
Rumex crispus	
Xanthium spinosum	1 seen
Pasture 2	
Baccharis pilularis	
Brassica nigra	
Centaurea solstitialis	
Erodium moschatum	
Foeniculum vulgare	
Geranium dissectum	
Hazardia squarrosa	
Hemizonia luzulaefolia	
Marrubium vulgare	
Medicago polymorpha	
Nassella sp.	
Nicotiana glauca	road cut
Opuntia littoralis	1 plant
Phalaris aquatica	
Plantago lanceolata	
Ranunculus californica	
Rumex crispus	
Silybum marianum	road area
Pasture 3	

Achillea millefolium	
Baccharis pilularis	
Brassica nigra	
Calystegia subacaulis ssp. episcopalis	
Carduus pycnocephalus ?	too decayed for positive ID
Centaurea solstitialis	
Chlorogalum pomeridianum	
Dipsacus fullonum	
Elymus glaucus ?	no inflorescences present, 1 patch on North end
Epilobium canum	
Erodium moschatum	
Eucalyptus camaldulensis	
Foeniculum vulgare	
Geranium dissectum	
Hazardia squarrosa	
Hemizonia luzulaefolia	
Medicago polymorpha	
Nassella sp.	
Phalaris aquatica	
Picris echioides	
Plantago lanceolata	
Polypodium californicum	
Ranunculus californica	
Rosa californica	
Rumex crispus	
Salvia spathacea	
Sisyrinchium sp.	
Symphoricarpos albus	
Vicia sp.	
Pasture 4	
Achillea millefolium	
Baccharis pilularis	
Brassica nigra	
Calystegia subacaulis ssp. episcopalis	
Centaurea solstitialis	

Chenopodium murale	summit
Epilobium canum	
Eremocarpus setigerus	
Erodium botrys	
Foeniculum vulgare	
Geranium dissectum	
Hazardia squarrosa	
Lactuca serriola	summit
Malva neglecta	summit
Medicago polymorpha	
Nassella sp.	
Nasturtium officinale	spring
Phalaris aquatica	
Picris echioides	
Plantago lanceolata	
Ranunculus californica	
Rumex crispus	
Silybum marianum	summit
unknown Iridaceae ?	spring
Vicia sp.	
Pasture 5/ Reference Area	
Brassica nigra	
Calystegia subacaulis ssp. episcopalis	
Centaurea solstitialis	
Eremocarpus setigerus	
Erodium botrys	
Foeniculum vulgare	
Geranium dissectum	
Medicago polymorpha	
Nassella sp.	
Phalaris aquatica	
Picris echioides	

Interpreting Indicators of Rangeland Health

The reference sheet developed for the rangeland health assessment is included as Appendix E. The evaluation matrix developed from the reference sheet is included as Appendix F. The evaluation sheets are included as Appendix G. The most notable features mentioned in the evaluation sheets are photographed in Appendix H. The results of the Rangeland Health assessment are summarized below in Table 5.

Table 5. Rangeland health indicators results summary. Results represent departure from reference state.

Pasture	Soil and Site Stability	Hydrologic Function	Biotic Integrity
1	None to Slight	None to Slight	None to Slight
2	None to Slight	Slight	Slight
3	Slight	Slight	None to Slight
4	None to Slight	None to Slight	Slight
5	None	None	None to Slight

The indicators most variable among the pastures and reference area were bare ground, gullies, soil surface loss or degredation, functional/structural groups, litter amount, annual production, invasive plants, and reproductive capability of perennial plants. Many of the seventeen indicators in the evaluation were not present or significant in any of the pastures. Completely absent were rills, pedestals and/or terracettes, wind-scoured, blowouts, and/or depositional areas, and plant mortality/decadence. Litter movement was absent to limited in all pastures, as were compaction layers and water flow patterns. All soil samples scored the highest rating (6) for soil surface resistance to erosion, which was not surprising considering the high clay content of local soils.

DISCUSSION AND CONCLUSION

The pastures assessed at the Cal Poly sheep unit are in fairly good condition, especially when compared against other grazed rangelands in San Luis Obispo County. The reference area established should be adequate to complete rangeland health assessments for the northern sheep unit pastures and other similar area pastures in the future. Although the past stocking rate is not known, the low frequency of grazed plants, the low intensity of herbage removal on grazed plants, and high levels of litter and residual dry matter suggest the stocking rate has been low in recent years. Therefore, the reference area selected is one of the best areas for referencing potential forage productivity and species composition. Native perennial grasses are still abundant across most of the unit, and noxious weeds have not made major inroads. Plants regarded as weeds (e.g. *Foeniculum vulgare*, fennel) are being grazed by the sheep. The sheep are apparently selecting the fennel despite the plant's tall height, the strong taste, and the abundance of grass. However, the small patch of yellow starthistle (*Centaurea solstitialis*) in the middle

of the assessment area is worrisome. Managers should work on controlling this patch before it spreads to infest other areas and degrade forage production and biotic integrity. Soil disturbed by ground squirrels is causing soil surface loss in steep areas and is providing an opportunity for weedy undesirable species such as thistles to become established. The old road in pasture 2 has caused some erosion and weed problems. Invasive species control, gully monitoring and halting, road removal, and ground squirrel control are the only remedial actions recommended to improve the stability and biotic integrity of the site.

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